

# A New Pulsed Cold Neutron Beam Line at LANSCE for Fundamental Nuclear Physics

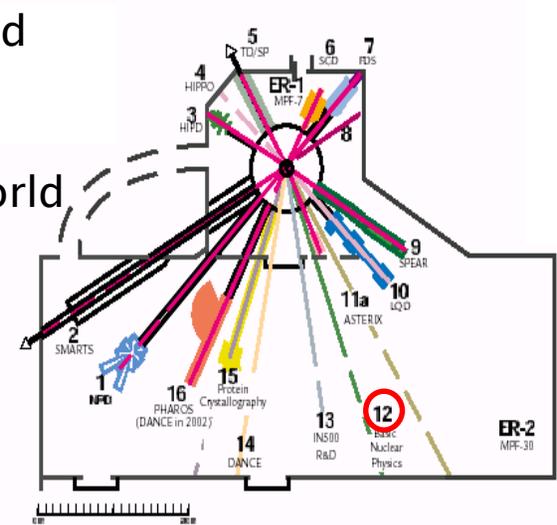
Pil-Neyo(Pil) Seo  
Los Alamos National Laboratory  
for NPDGamma Collaboration

April 5, 2004  
International Conference on Precision Measurement with Slow Neutrons  
Gaithersburg, NIST



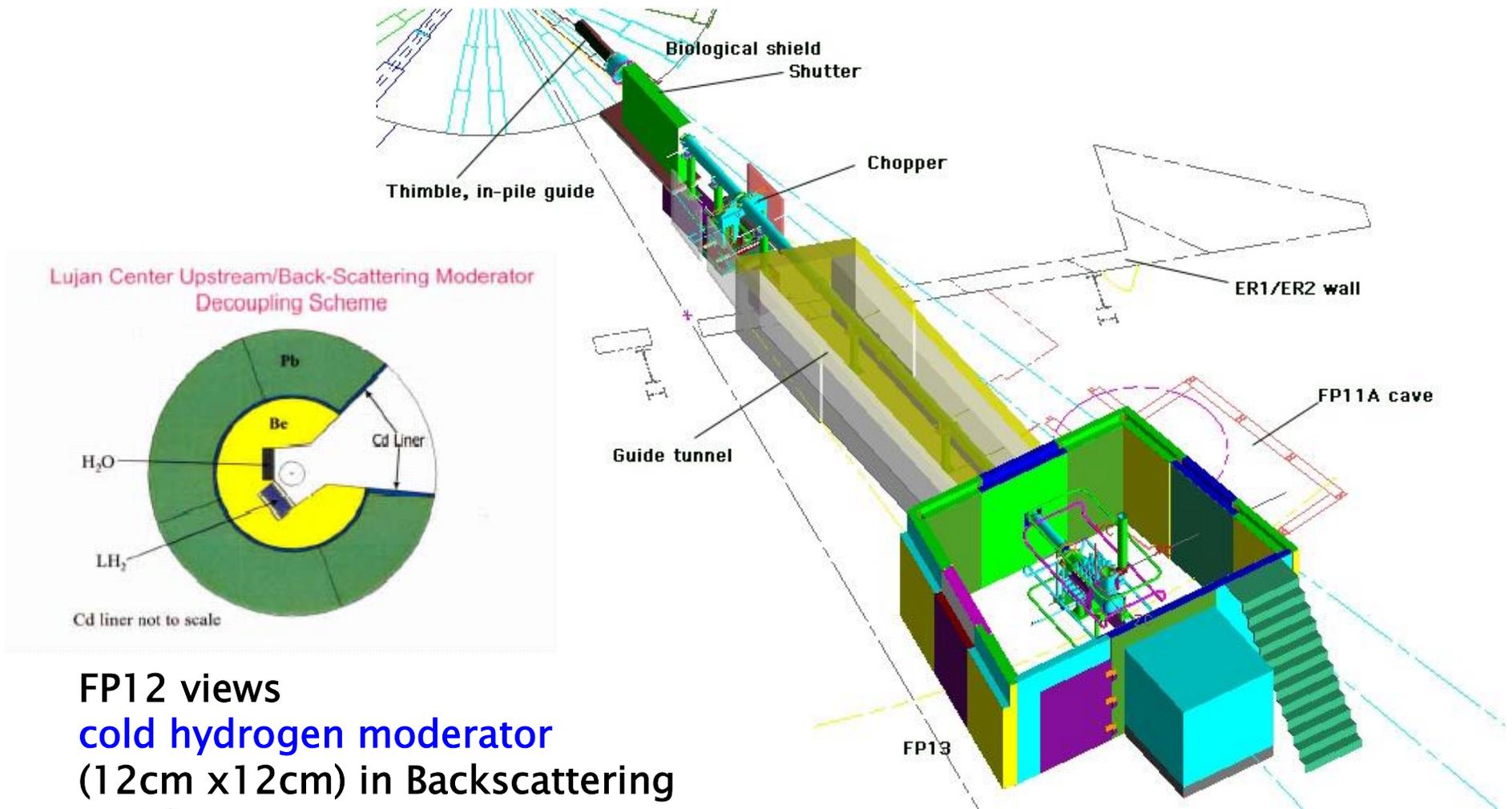
# FP12: A New Cold Neutron Beam Line at LANSCE

- Three out of 16 beam lines are for nuclear physics
- FP12 is the only cold neutron beam line and dedicated to study fundamental nuclear physics
- Highest pulsed cold neutron beam intensity in the world for nuclear physics
- First beam on Feb. 12, 2004
- First experiment is  $\vec{n}+p \rightarrow d+\gamma$  (NPDGamma)



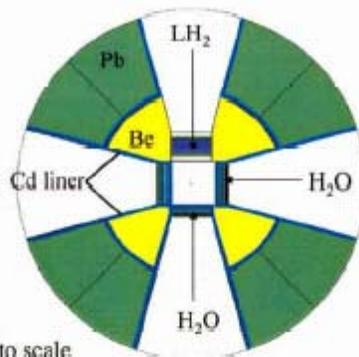
- As a probe of the hadronic weak interaction, NPDGamma aims to measure a pion-coupling constant,  $f_{\pi}$ , in N-N interaction by observing PV directional gamma-ray asymmetry in the reaction  $\vec{n}+p \rightarrow d+\gamma$ .  
Predicted value:  $5 \times 10^{-8}$ , NPDGamma goal: 10% precision
- This high precision measurement requires 1) high flux for statistics, 2) accurate energy information from TOF and thus to control systematic errors
- Detailed NPDGamma commission talks on Wed (4/7, 8:30–9:05)

# Conceptual Design of the Cold Neutron Beam Line



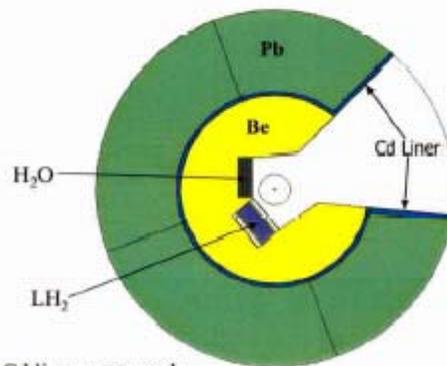
FP12 views  
cold hydrogen moderator  
(12cm x12cm) in Backscattering  
and flux-trap geometry

### Lujan Center Flux-Trap Moderator Decoupling Scheme



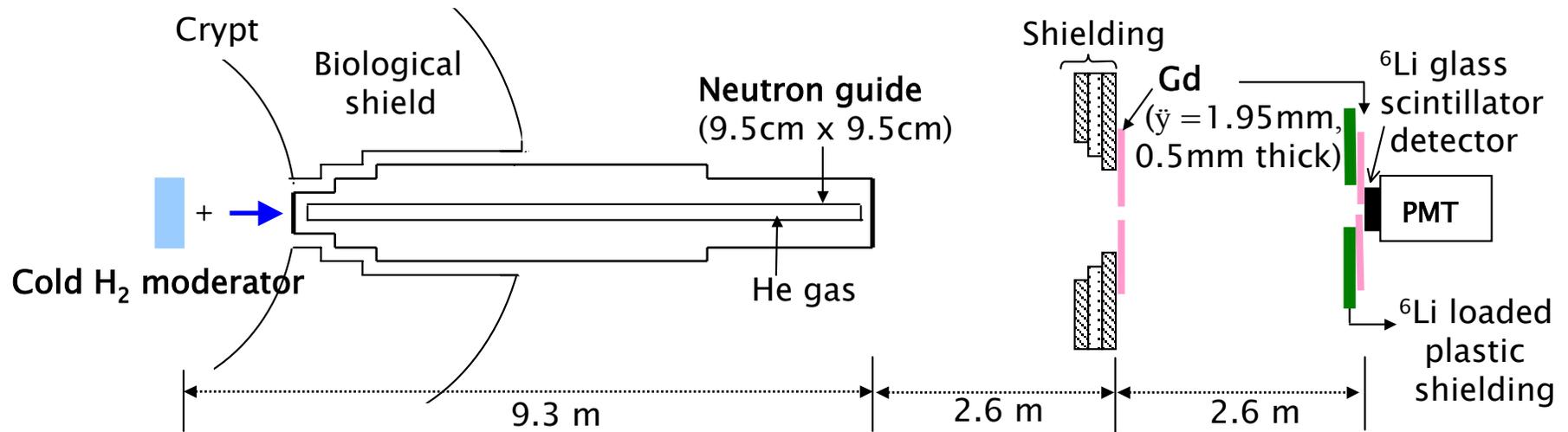
Cd liner not to scale

### Lujan Center Upstream/Back-Scattering Moderator Decoupling Scheme



Cd liner not to scale

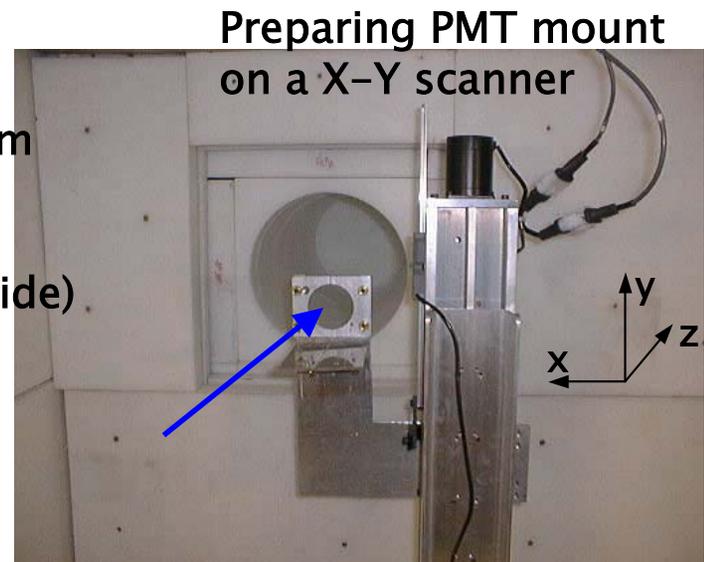
# Moderator Brightness Measurement



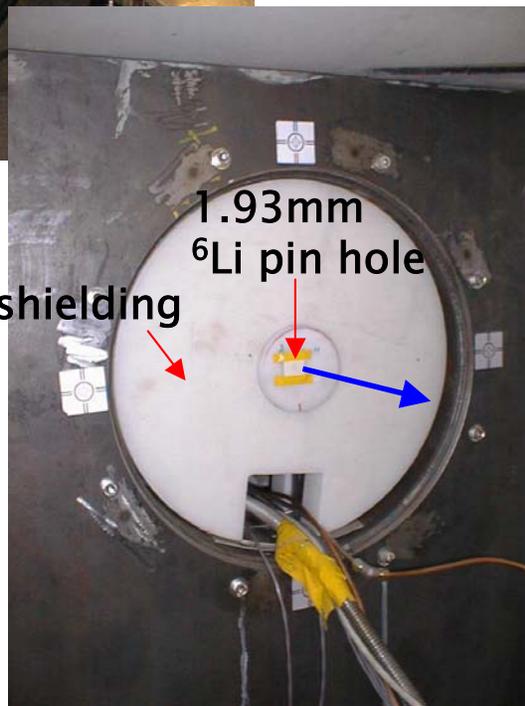
- Unique moderator in the world
- Never measured before but modeled
- NPDGamma precision measurement needed to know the sensitivity @LANSCE
- Two pinhole system views the moderator
- Brightness counts only direct neutrons from the moderator



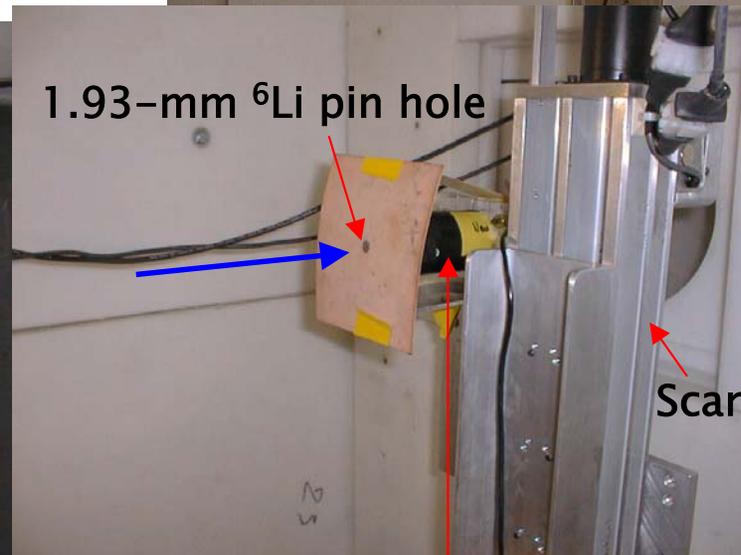
Aligning an upstream pin hole (~1 mm accuracy respect to the center of the guide)



Preparing PMT mount on a X-Y scanner



1.93mm  $^6\text{Li}$  pin hole  
shielding

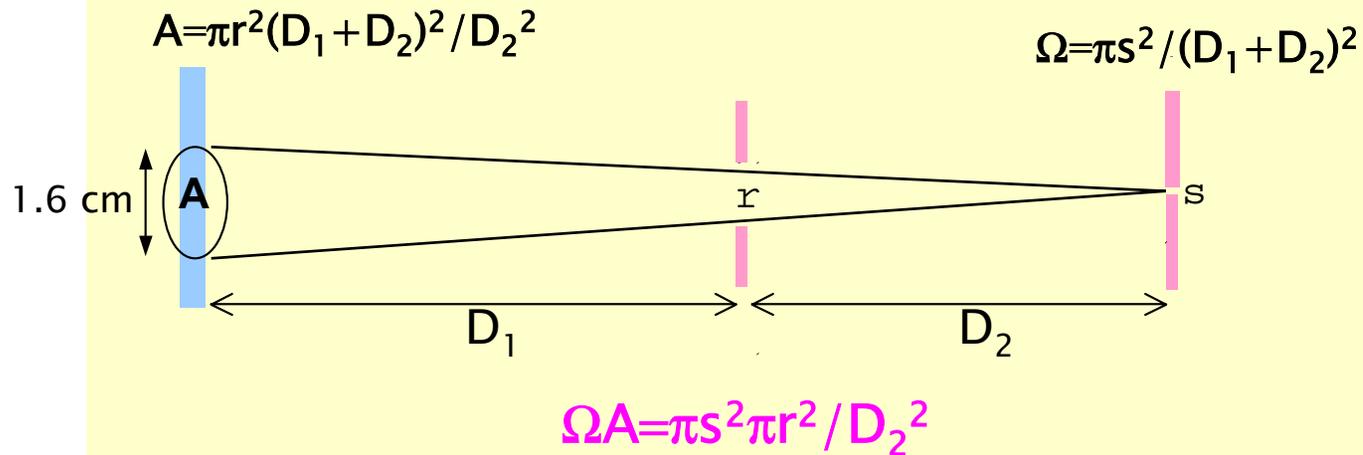


1.93-mm  $^6\text{Li}$  pin hole

Scanner

PMT (Phillips XP-2262/B)

## Two-pin-hole System

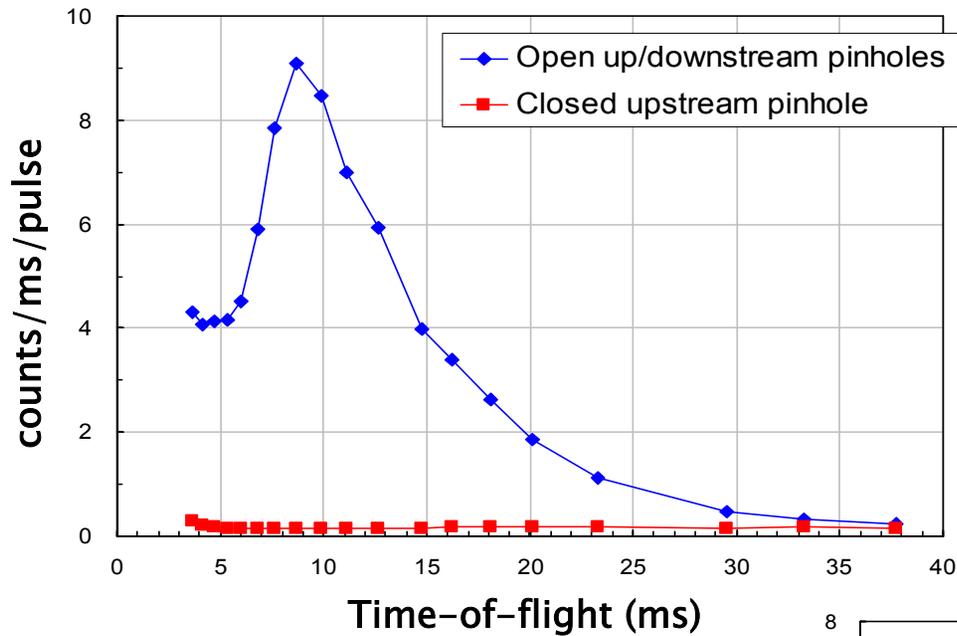


## Moderator Brightness (n/meV/s/ $\mu$ A/cm<sup>2</sup>/sr)

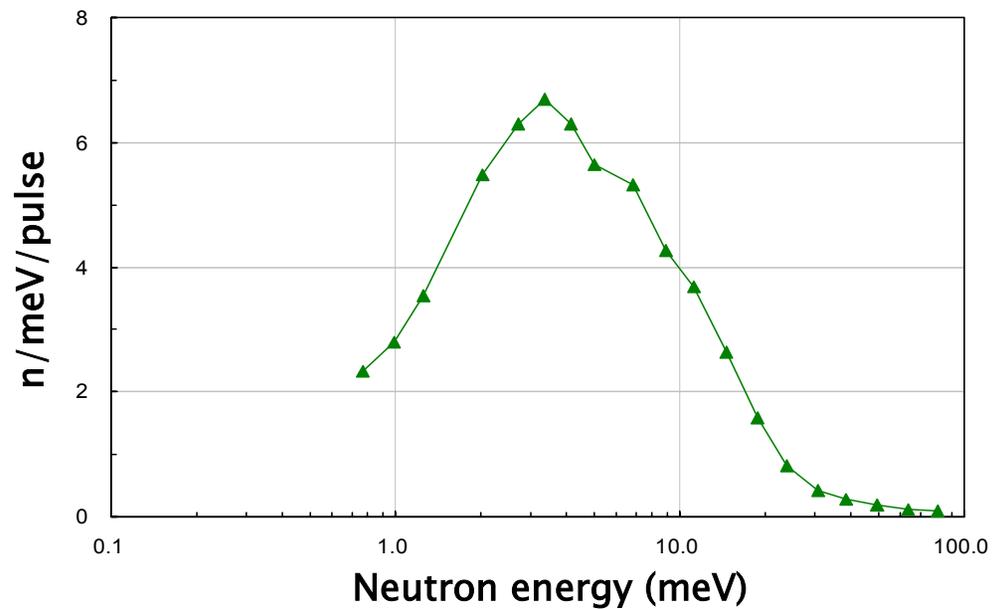
neutrons normalized

$$\frac{(N-B)}{\text{Active time}} (\text{n/ms/pulse}) \times \frac{T}{2E} (\text{ms/meV}) \longrightarrow [\text{n/meV/pulse}]$$

$$[\text{n/meV/pulse}] \times 20 \text{ pulses/s} \times \frac{1}{\text{Proton current } (\mu\text{A})} \times \frac{1}{\Omega A}$$

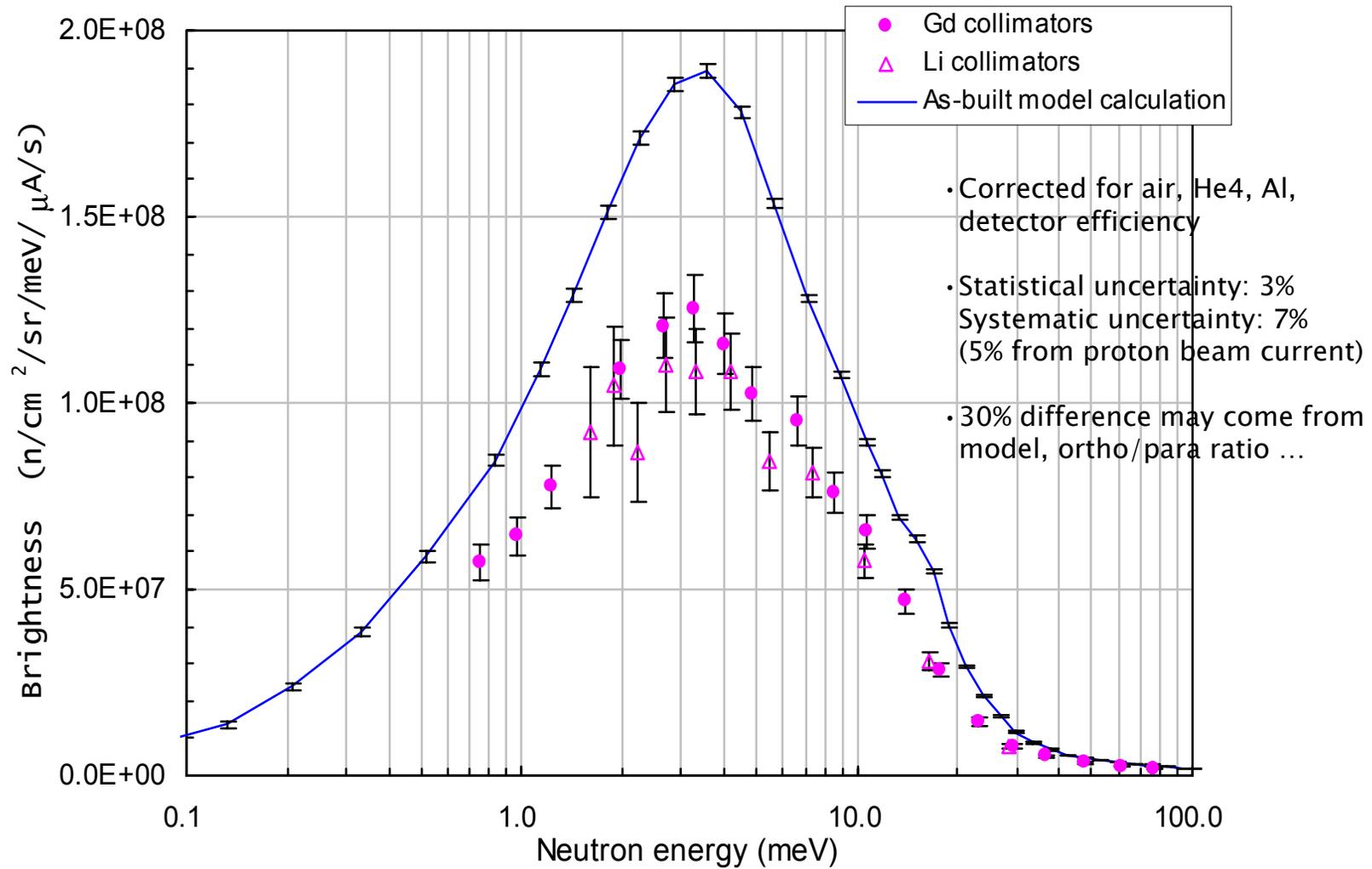


- Raw data
- Time-of-flight spectra
- Energy spectrum
- 0.8–80 meV (10.1–1.0 Å) region
- Dead time losses @ 9kHz=0.7%

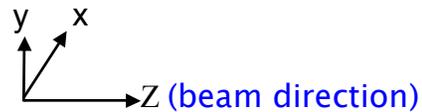
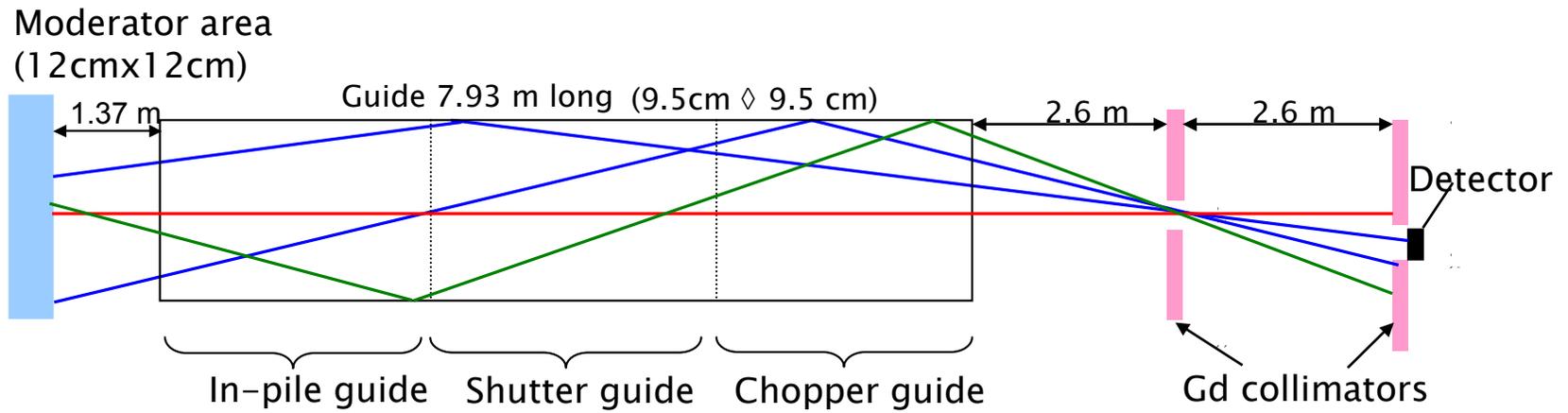


# Measured FP12 Moderator Brightness at LANSCE

Seo et al., NIM A517, 285 (2004)

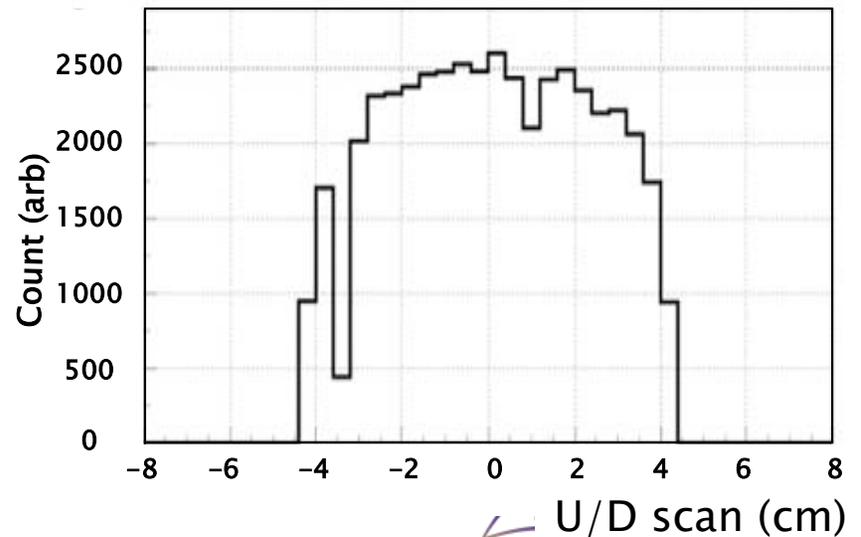
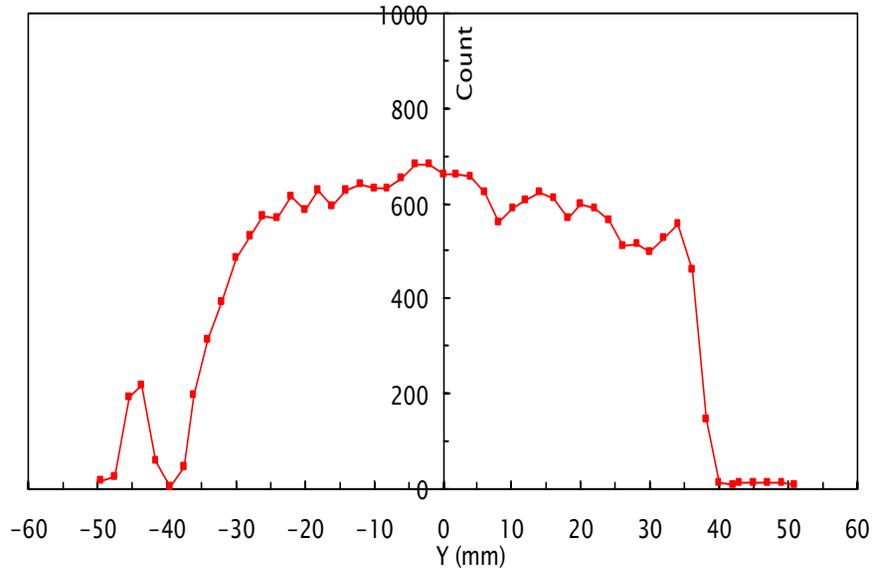
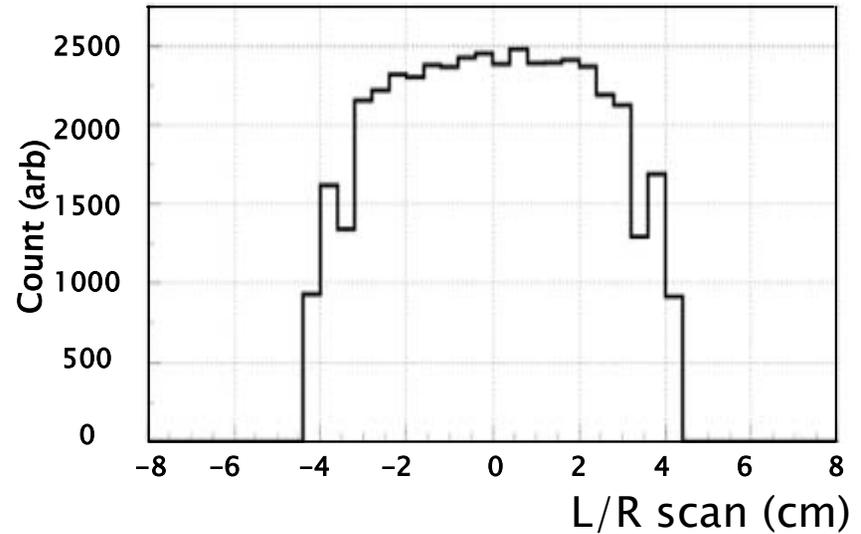
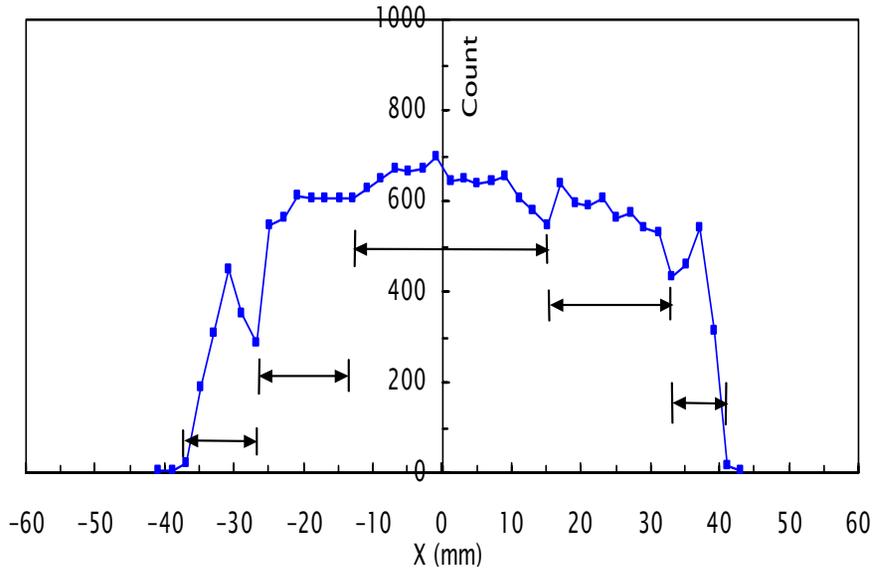


# Study of Guide Performance with the First Part of $m=3$ Neutron Guide

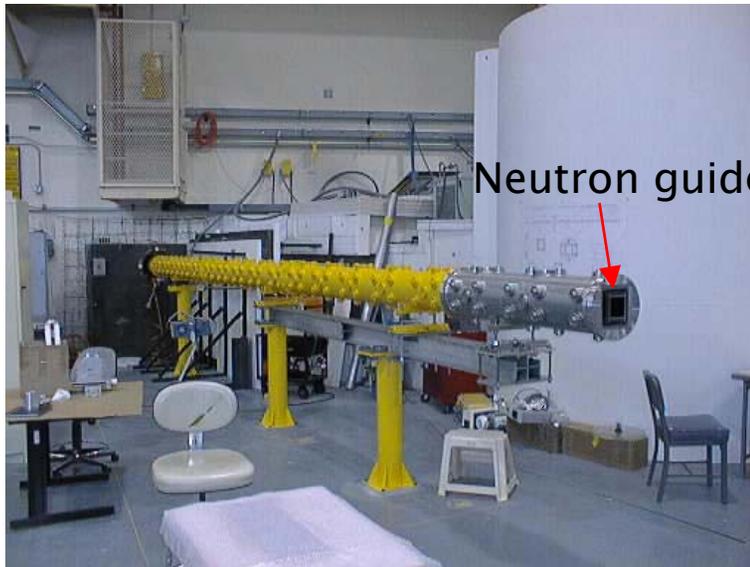


# Results of FP12 Neutron Guide Study with 10 meV

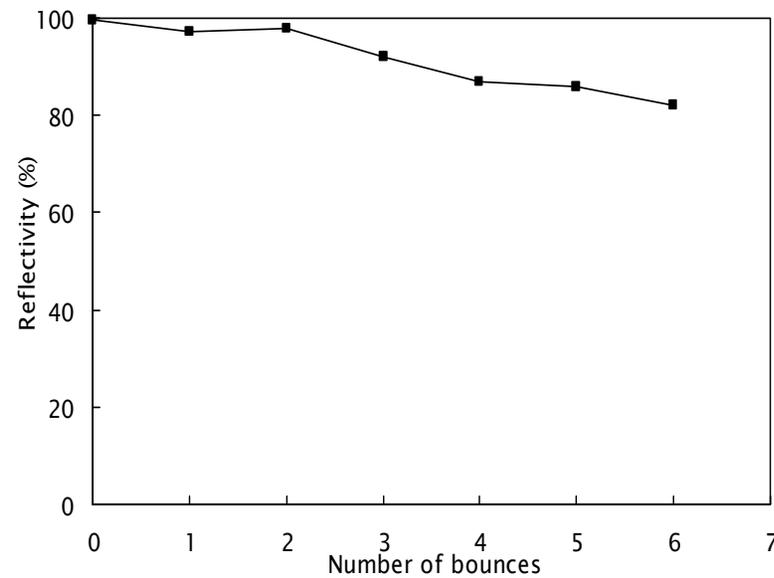
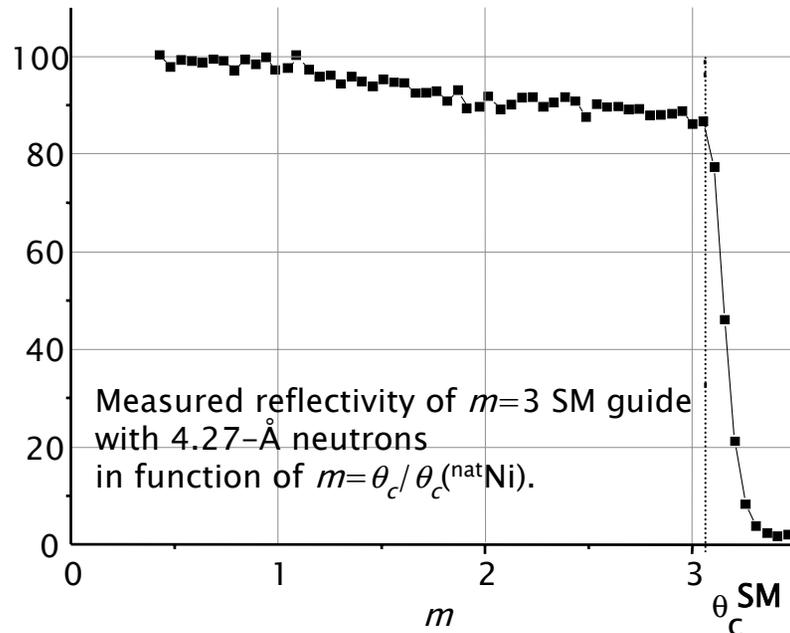
$m=3$  cutoff near  $\pm 40$  mm in x and y



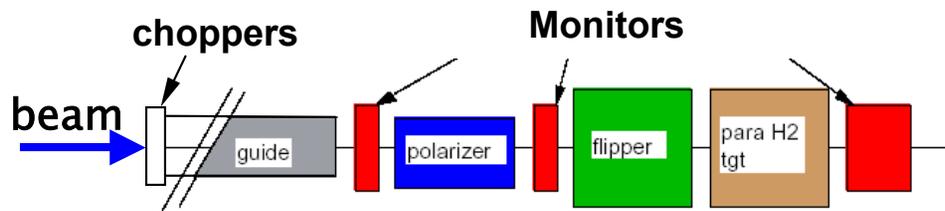
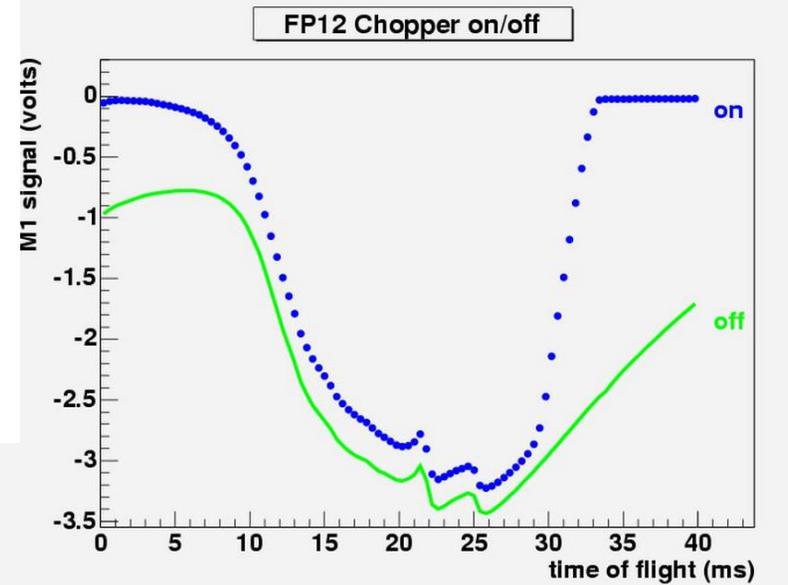
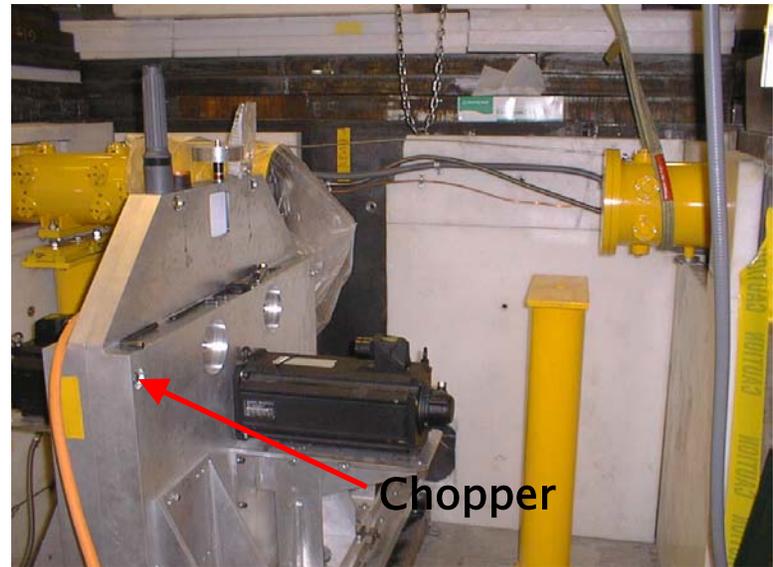
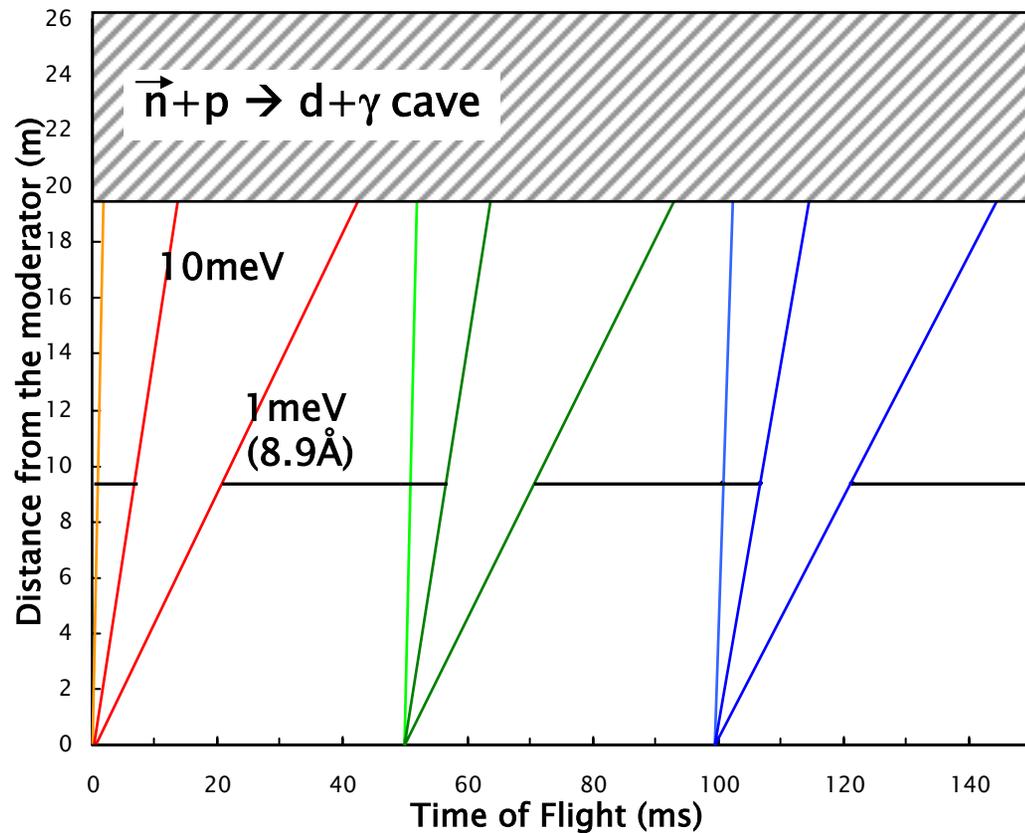
# Full Scale of the Neutron Guide Installation



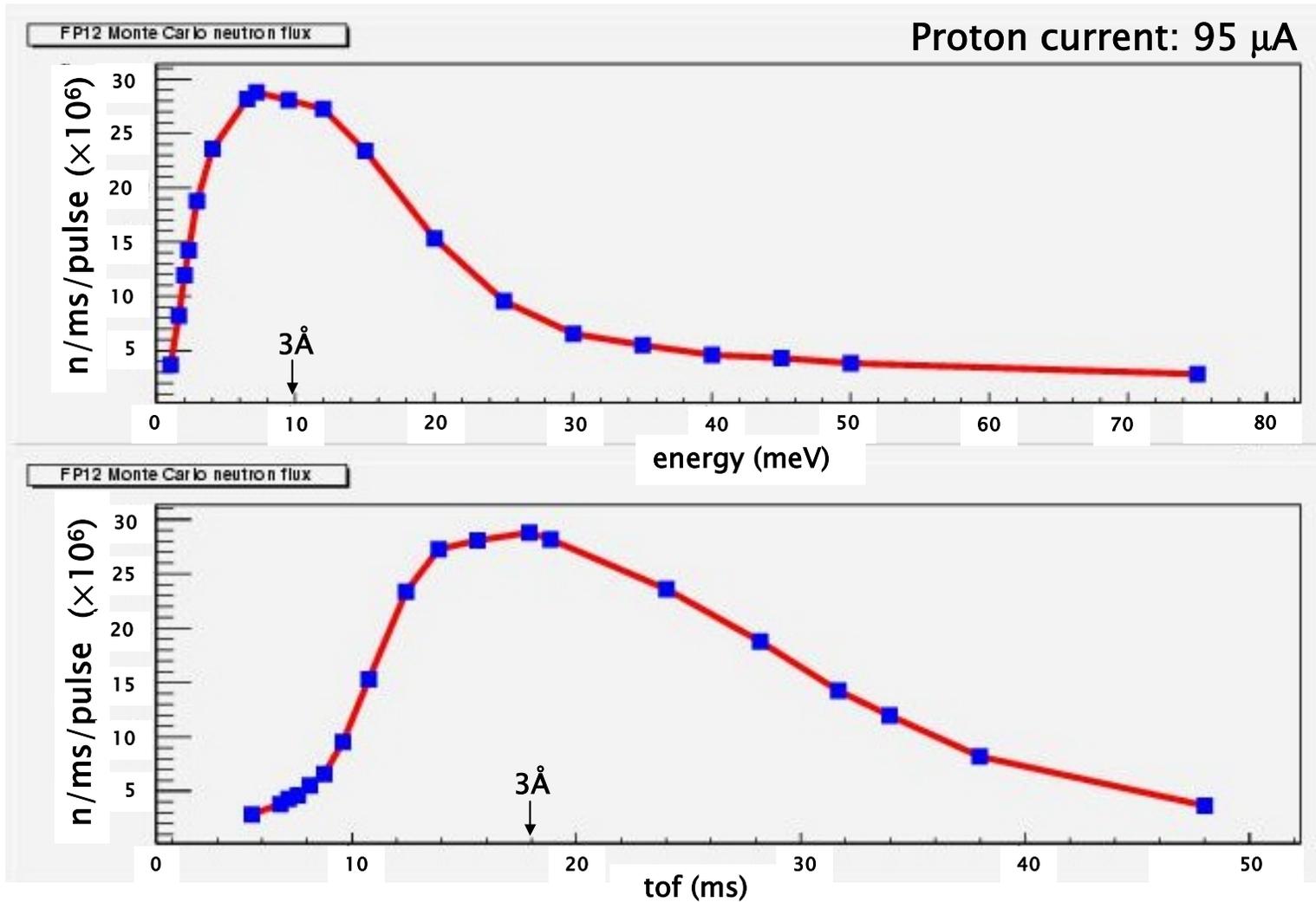
Reflectivity (%)



# Two Frame Definition Choppers at 9.38m from the Source



# FP12 Neutron Flux out of the Guide



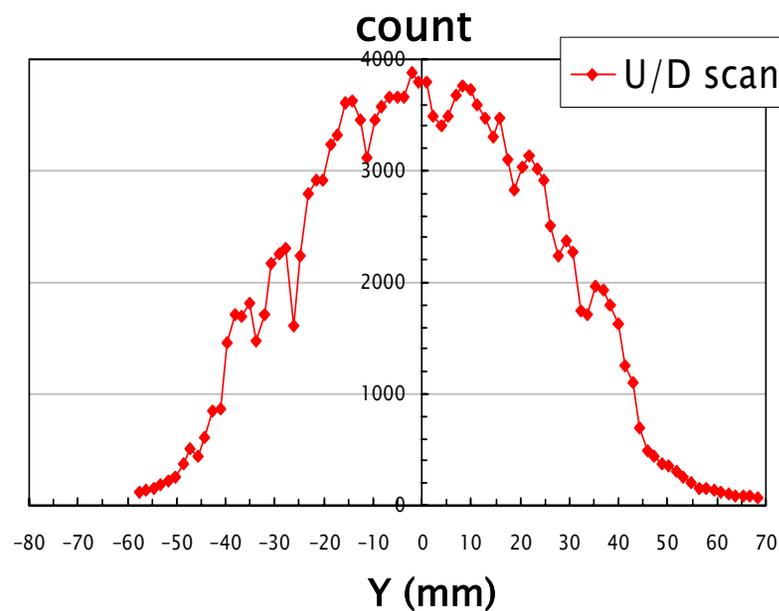
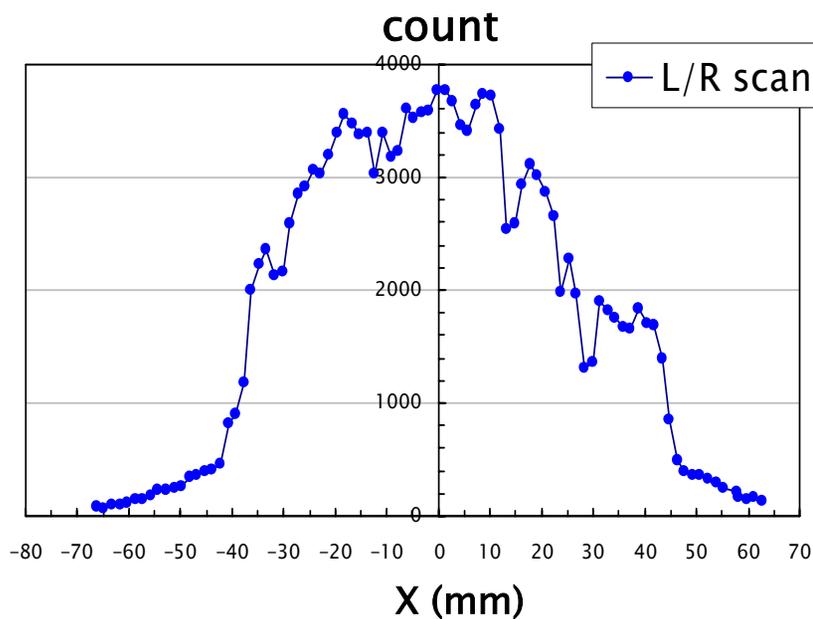
# Brightness Measurement Result

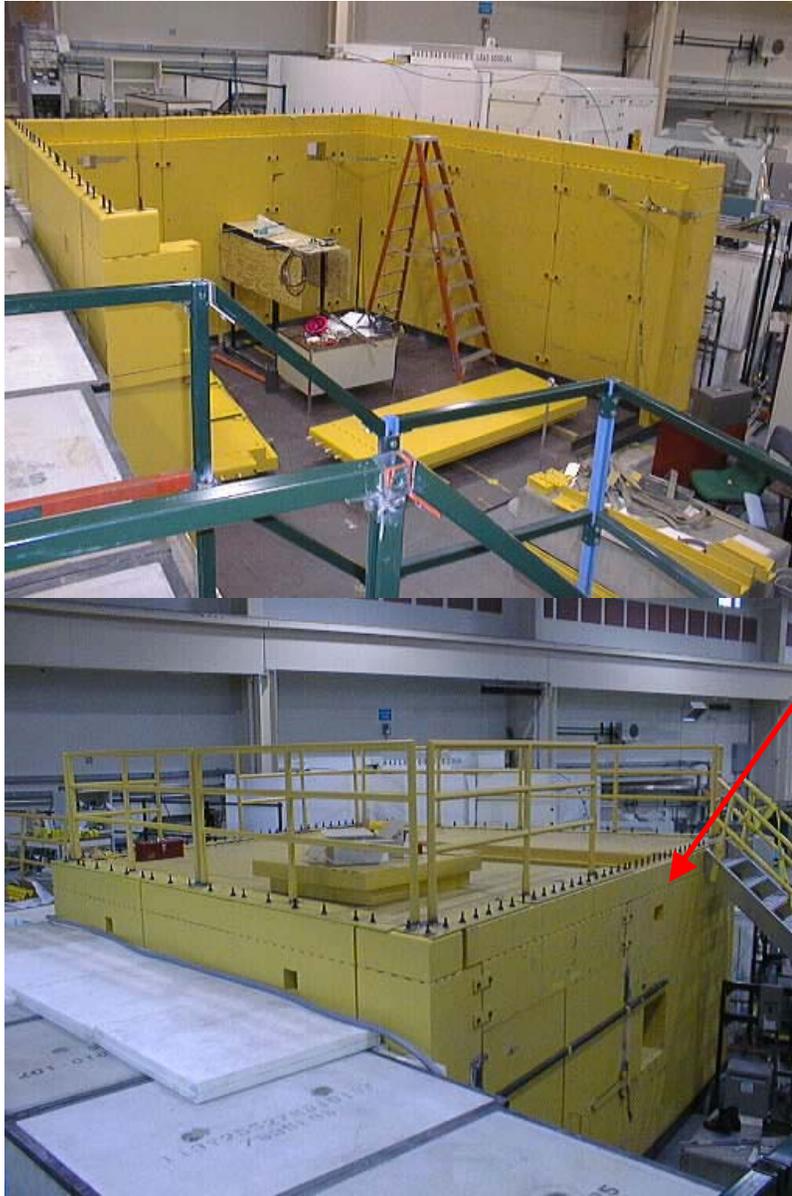
2004 brightness at 3meV:  
1.245 n/s/cm<sup>2</sup>/sr/μA/meV

agrees

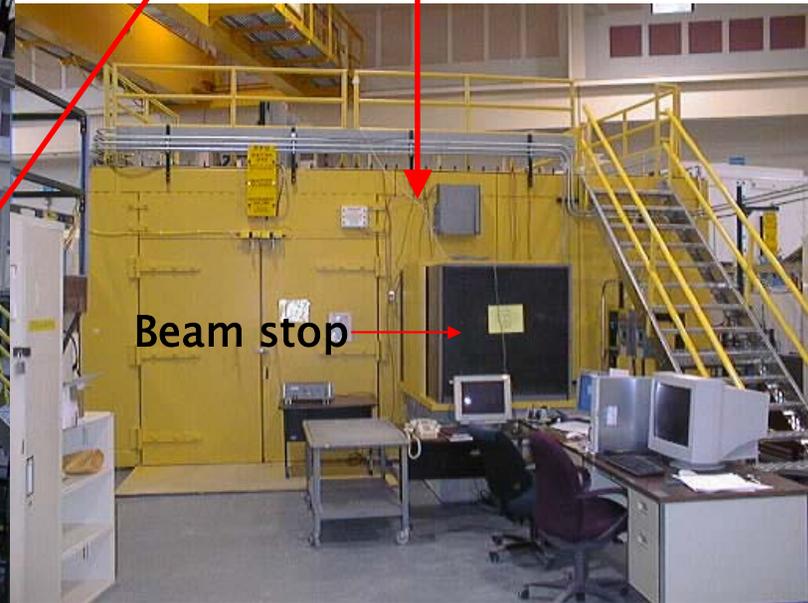
2003 brightness measurement:  
1.253 n/s/cm<sup>2</sup>/sr/μA/meV

## Guide Scan Results





FP12 cave construction completed in January 2004



# Commission for Cold Neutron Beam Line Completed (March 12, 2004)



# Summary

1. A new pulsed cold neutron beam line at LANSCE was constructed for fundamental nuclear physics
2. World's highest intensity of pulsed cold neutrons for nuclear physics
3. TOF allows accurate energy information, precise polarimetry to control systematic errors
4. The first experiment  $\vec{n}+p \rightarrow d+\gamma$  is under commissioning